PATENT COOPERATION TREATY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2005/000598	21.01.2005	21.01.2004

International Patent Classification (IPC) or both national classification and IPC
H01J37/28

Applicant
ICT INTEGRATED CIRCUIT TESTING GESELLSCHAFT ...

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/EP2005/000598

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	7, 8, 10, 12-14, 16-18, 20, 29, 32-38
	No:	Claims	1-6, 9, 11, 15, 19, 21-28, 31
Inventive step (IS)	Yes:	Claims	12-14, 16, 20, 32, 33, 37, 38
	No:	Claims	1-11, 15, 17-19, 21-31, 34-36
Industrial applicability (IA)	Yes:	Claims	1-38
	No:	Claims	

2. Citations and explanations

see separate sheet

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability

1. Reference is made to the following documents:

   D1: EP 0 762 468 A (Hitachi Ltd.) 12 March 1997
   D2: EP 0 732 726 A (Hitachi Ltd.) 18 September 1996
   D3: US 2004/0000640 A (Hiroyoshi Kazumori) 1 January 2004
   D4: US 6 037 589 A (Osamu Takaoka et al.) 14 March 2000
   D5: US 6 504 164 B (Seiji Morita et al.) 7 January 2003
   D6: WO 02/37523 A (Koninklijke Philips Electronics N.V.) 10 May 2002

2. The subject-matter of present claims 1 and 2 is not new in the sense of Article 33(2) PCT. Document D1 discloses a scanning electron microscope (cf. Fig. 1) comprising a magnetic objective lens (6) to focus an electron beam onto a sample (7). Axisymmetric accelerating electrodes (10a, 10b) are arranged on an electron beam passage of said objective lens, and the electron beam is focused by the action of an electrostatic lens formed in the gap between said accelerating electrodes (cf. column 4, line 46 - column 5, line 52).

   The prior art points out that the rotational symmetry of the electric field between the sample and the accelerating electrode is distorted when the sample is inclined with respect to the electron beam. Hence, an axisymmetric electric field correction electrode (11) is arranged outside of the accelerating electrode (10b) in order to compensate for such landing angle dependent distortions of the focussing electric field (cf. column 3, line 52 - column 4, line 36; column 5, line 53 - 59). Figures 4 and 5 illustrate this effect in detail (cf. column 6, line 31 - column 7, line 4).

   The device disclosed in document D1 thus comprises a first electrode having a first aperture to generate a focussing electric field and a correcting electrode and is thus considered to represent a focussing lens as defined in present claim 1.

   As the correction electrode is axisymmetric, its surfaces parallel to the symmetry axis are curved (circular). Furthermore, one of the embodiments (cf. Fig. 8) also

comprises a cone-like shaped correction electrode as defined in present claim 2.

3. It is well known in the prior art to use correction lenses in order to compensate for landing angle dependent distortions of the focussing electric field. As such lenses are usually arranged symmetrically around the beam axis, they do have a "curved surface" as required in present claim 1.

The deflecting electrode device (17) shown in document D2, for instance, which corrects a lateral electric field component generated on the beam axis when the sample is tilted with respect to the beam, is formed of one (cf. Fig. 6) or a plurality (cf. Figs. 2, 4, 5) of segments having a curved surface (cf. abstract).

Document D3 shows a cylindrical shield electrode (8) providing the desired correcting effect (cf. paragraph [0023], [0024]). Strictly speaking, said document does not mention a focussing electric field as defined in present claim 1, but the beam is focussed by a magnetic objective lens (3). However, an electric retarding field is applied between said lens and a sample as a part of this focussing system (cf. [0015]-[0016]). As the electric field is distorted in case the sample is tilted with respect to the beam, high resolution is obtained by the correcting electrode (8) removing these adverse effects.

4. Several of the optional features of the focussing lens as defined in dependent claims are either already disclosed in (Article 33(2) PCT), or at least rendered obvious by (Article 33(3) PCT), the cited prior art, the objections being summarized in the following:
Claim 4: In all documents, the correcting electrode is aligned to be rotationally symmetric with respect to the symmetry axis of the aperture of the objective lens.
Claims 3, 5-7 and 15: In an embodiment shown in document D2 (cf. Fig. 6), the deflection device (17) is disposed opposite to the tilted sample (7), however still obtaining the desired correcting effect (cf. column 3, lines 12-36). Although not explicitly mentioned, it is obvious that such a device is easily realized omitting one of the electrodes (19, 20) as shown in figure 2. Such a half-circle, however, can be considered as a lens having an "opening" (i.e. the omitted other half-circle) to provide space for the tilted sample to approach the objective lens. In this case, the correction

device encircles the beam axis by a covering angle of about 180 degrees. Moreover, figure 6 clearly shows that providing such an "opening", the sample can be brought closer to the focussing lens than the distance between said focussing lens and the correction lens. Hence, at the present understanding, the subject-matter of claims 3, 5, 6 and 15 referring to independent claim 1 is already anticipated in said document D2. Moreover, it seems worth to mention that a correcting electrode according to document D1, surrounding the aperture of the objective lens, falls within the scope of dependent claims 6 and 7.

Claim 8: The cited documents are silent as regards the fixture of the correction lens. However, it seems to be a normal design option to rigidly fasten said lens to the focussing lens.

Claim 9: Figure 6 of document D1 illustrates that different voltages are provided to the correction lens (Vb) and the first focussing electrodes (Va1, Va2).

Claim 11: In all documents, both the first electrode and the correction electrode are aligned to be rotationally symmetric to the beam axis, hence the correction electrode is also considered to face said first electrode conformally.

Claim 17: Actually, the sample does not form part of the claimed invention, and it remains unclear to what extent the size of the specimen to be treated with the beam implies any restriction as regards the focussing lens. Thus, although the abovementioned prior art does not mention the size of the planar sample, it does not involve an inventive step to merely define a specific size.

Claim 18: Document D1 does not mention the vertex angle of the cone-shaped correction lens shown in figure 9. However, it is not considered to require an inventive step to define such a broad range as from 30 to 160 degrees.

Claim 19: The objective lens (6) disclosed in documents D1 and D2 contains a coil for providing a focussing magnetic field.

5. It follows from the abovementioned that the subject-matter of present claim 21 is neither new nor inventive with respect to the prior art disclosed in documents D1 to D3, as in addition to the focussing lens, each of the SEMs presented in these documents also comprises an electron source (1). The SEMs according to the prior art comprise a tilting mechanism to tilt the surface of a sample with respect to the symmetry axis of the SEM including the focussing lens between at least two different landing angles (claim 22), and at least document D1 mentions explicitly that besides

a vertical landing angle (i.e. $\theta = 0°$), the sample might be tilted by angles up to at least 60° (cf. Fig. 6) (claim 23). Although the vertex angle of cone-shaped objective lens (6) is not mentioned, it appears that this large range from 0° to about 60° of the inclination angle also includes half of said cone vertex angle (claim 24). Moreover, since the SEM has an axisymmetric structure, the tilting plane always equals the symmetry plane of the focussing lens (claim 25). Hence, the optional features defined in claims 22 to 25 are either known from, or at least rendered obvious by, the abovementioned prior art.

6. Independent claim 36 is based on a combination of claims 1 to 3, thus its subject-matter lacks inventive step for the reasons set out in paragraphs 2 and 4.

7. The method as defined in present independent claim 26 is not new in the sense of Article 33(2) PCT. Document D1 provides a scanning electron microscope having a correcting electrode (cf. above paragraph 2) and points out that for inspecting a sample at a first inclination angle from 0° to around 45°, a first voltage |Vb| is applied to the correcting electrode, and when further enlarging the sample inclination, a second higher voltage is applied to said correcting electrode (cf. Fig. 6; column 7, line 52 - column 8, line 3).

   Document D2 also explains that in order to obtain the desired correcting effect, different voltages are applied to such a correcting electrode in accordance with the tilting of a sample (cf. column 2, lines 12-28). It is obvious that inspection of a sample might be performed at two different landing angles θ_1 and θ_2 and that thus two different voltages $V(\theta_1)$ and $V(\theta_2)$ are applied to the correcting electrode.

8. As explained in above paragraph 3, document D3 discloses an electrode (8) to correct the distortion of the electric field generated between the objective lens (3) and the sample (4). Said correcting electrode is appropriately spaced from the specimen according to the height of the specimen and information about the tilt angle θ. In other words, when the inclination of the sample with respect to the beam is increased from a first angle θ_1 to a second angle θ_2 during operation, the position of the correcting electrode is thus adjusted accordingly (cf. [0020]-[0022]; [0025]). Hence, the subject-matter as defined in present claim 27 is not new with respect to the

content of document D3.

9. As documents D1 to D3 use a similar device as defined in claims 21 to 25 (cf. paragraph 5), the subject-matter of claim 28 is not new either. Moreover, it is not regarded as inventive to select a first inclination angle close to 0°, such that the beam impinges almost vertical on the surface of the sample (cf. claim 29), and a second inclination angle from 20° to about 70° (cf. claim 30), since scanning the sample at different angles obviously provide different, complementary information on the sample, and a skilled person could arrive at suitable angles by routine trial and error. A similar objection applies to the different positions defined in claim 35.

10. Claims 31 to 33 refer to independent claim 27, although a first and second voltage is not defined in said claim. It appears that said dependent claims should rather refer to independent claim 26. A similar objection applies to independent claim 38 based on a combination of claims 27 and 31 to 33. Furthermore, it is pointed out that according to the method disclosed in document D3, the voltage applied to a correcting electrode (8a) is equal or slightly lower than the voltage applied to the specimen (cf. paragraph [0024]).

11. Independent method claims 26, 27, 37 and 38 do not mention a correcting electrode having a curved surface as defined in present claim 1 or a cone-like shaped curved surface as defined in claim 36. Notwithstanding above objections against lack of novelty of the subject-matter defined in these claims, it thus remains uncertain which features are actually essential to the invention.

    Rather, the methods according to claims 26, 27, 37 and 38 appear to be applicable to any correcting lens, i.e. it is not clear which general inventive concept links the subject-matter defined in claims 1 to 25 and 36 with a method according to any of the claims 26 to 35, 37 and 38.

12. The selection of a second correcting voltage of about 2·Vs–V1, depending on the voltage V1 applied to a focussing electrode and the specimen voltage Vs, such as defined in claims 33, 37 and 38, is neither disclosed, nor indicated, in the cited prior art. The subject-matter of these claims is therefore considered to meet the

requirements of the PCT with respect to novelty and inventive step.